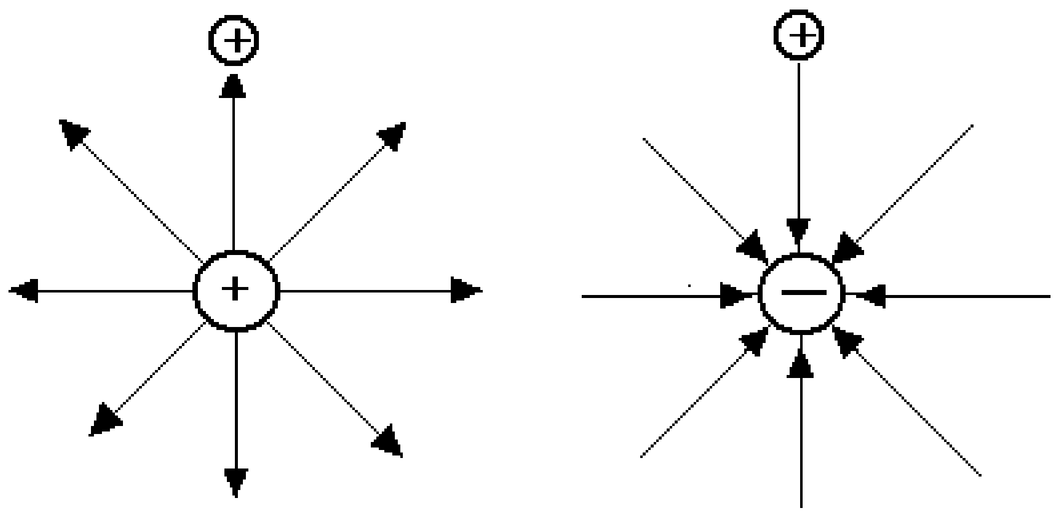
Electric Field Strength

The electric field strength **E** for any charged object is equal to the force experienced by a unit positive test charge placed at that point. The field around point charges is radial and has the direction that an *imaginary* positive test charge would take if released near the charge.

If a line of force is the path a positive charge will take in the field, then the following must be true:

- lines must repel each other.
- the closer together two lines are, the more they repel each other.
- many lines close together suggests a strong field.
- lines never cross.



There are two ways of expressing electric field strength:

- by definition, the field strength is equal to the force acting per coulomb of charge, so

$$\mathbf{E} = \frac{\mathbf{F}}{\mathbf{q}}$$

with units being N/C

- by combining the above formula with the equation for determining electrostatic force,

$$\mathbf{E} = \frac{\mathbf{F}}{\mathbf{q}} = \mathbf{k}\frac{\mathbf{qQ}}{\mathbf{R}^2} \times \frac{\mathbf{1}}{\mathbf{q}} \rightarrow \boxed{\mathbf{E} = \mathbf{k}\frac{\mathbf{Q}}{\mathbf{R}^2}}$$

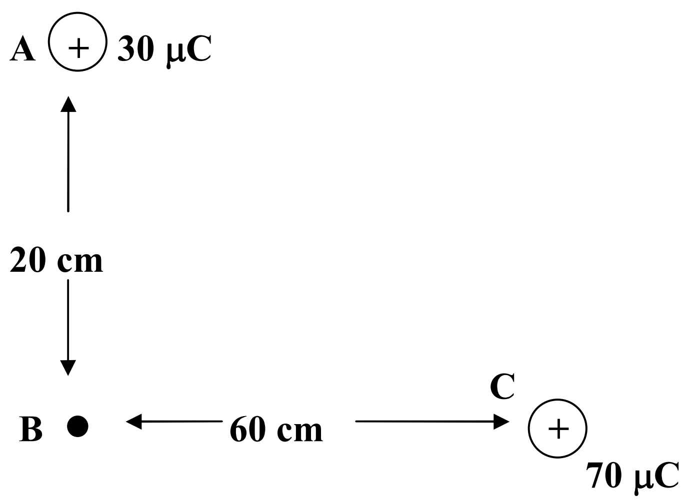
Note that electric field strength is sometimes called *electric intensity*.

Example 7. A 6.0 μC charge and a 4.5 μC charge are positioned 1.6 cm apart. If the smaller charge is removed, what is the electric field strength at the location of the 4.5 μC charge, due to the larger charge?

(see Electrostatics Ex 7 for answer)

When two or more electric fields act at one location the resultant field is given by the vector sum of the individual fields. This is the superposition principle.

Example 8. Find the resultant field at point B due to the two charges.



Since the electric field is a *vector* quantity, you need to utilize the same principles that were used to find electric force:

- draw a free-body diagram showing the vectors acting at **B**.
- calculate electric fields $\mathbf{E_A}$ and $\mathbf{E_B}$ (one at a time).
- use vector addition to find the net electric field.

(see Electrostatics Ex 8 for answer)